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Applicant : Qun Ying Lin
Reply to the Office action (ROA # 2) dated July 12, 2005

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Remarks/Arguments

Examiner Stephen Rosasco is thanked for the thorough Office Action.

In the specification

The spec p. 2, line 21 is amended to correct a typographically error.

No new matter is added.

In the claims

Parent claim 1 is amended to state:

"said first phase shift section and half tone section changing the phase of ~~incident transmitted~~ light by about 180 degrees with respect to said second phase shift section." For support see spec page 11, Lines 4 to 6; spec P 18, LL 20-22.

Applicant intends to claim that the of light transmitted thru the mask has a phase of about 180 degrees different in the "said first phase shift section and half tone section" relative to said second phase shift section. Applicant respectfully requests the examiner give some suggestions to acceptable wording if this is not acceptable.

Parent claim 8 has a similar amendment as that made to claim 1.

Parent claim 16 is amended to cancel a not essential limitation. This amendment is not made for an prior art reasons and is not a FESTO limitation.

Claims 29 and 30 are amended to correct typographical errors and to give proper antecedent basis.

These amendments are not made for an prior art reasons and are not a FESTO invoking limitations.

No new matter is added

Objection to the disclosure

The objection to the disclosure is acknowledged.

The specification page 2, line 21, is amended to delete "for a" before "method".

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Rejection under 35 USC 102(e)

Rejection of Claims 1, 2, 5, 8 and 13 are rejected under 35 U.S.C. 102(e) as being anticipated by Ishikawa (US 2004/0018436).

The rejection of Claims 1, 2, 5, 8 and 13 are rejected under 35 U.S.C. 102(e) as being anticipated by Ishikawa (US 2004/0018436) is acknowledged. Reconsideration is following remarks.

Overview of an example embodiment of applicant's invention

The embodiments provide a phase shift mask having a first phase shift section, a half tone section, and a second phase shift section. The embodiments' half tone section assists in balancing the intensity between light passing thru the first phase shift section and the second phase shift section.

Two mask embodiments comprise (1) a single trench half tone phase shift mask and (2) a dual trench half tone phase shift mask. Other embodiments include methods for making the masks and using the masks to make devices.

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Figure 1 shows a first embodiment of an single trench, half tone, alternating phase shift mask.

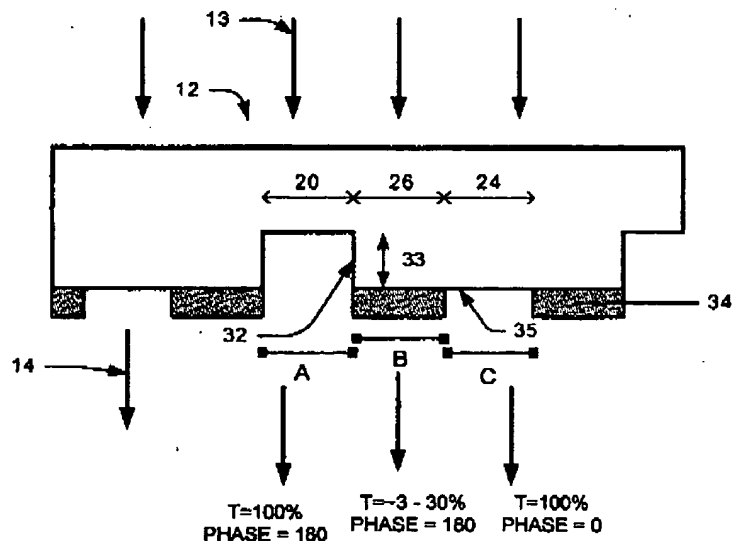


FIGURE 1A

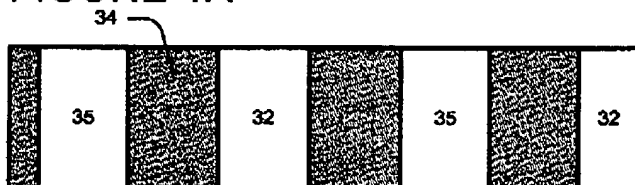


FIGURE 1B

Reference Ishikawa US 2004 001843 – Mask inspection method, mask defect inspection system, and method of production of mask

Ishikawa inventions involve mask inspection's. In order to expand the scope of the mask inspection methods and system, Isikawa gives examples of ordinary masks.

For example in paragraphs 0037 and 0038, referring to figure 1, Ishikawa discuss binary masks and half tone phase shift mask (no trenches).

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In 0039 and 0040, Ishikawa gives examples of phase shift masks.

In 0039 and 0040 Ishikawa does not mention any semitransparent films nor does Ishikawa mention that any light can pass thru the "light blocking film 2".

Claim 1 is non-obvious over Ishikawa because Ishikawa does not disclose CLAIM 1'S half tone section adjacent to layer in a trench phase shift mask and the .

Claim 1 states:

<p>1. (CURRENTLY AMENDED) A phase shift mask for use with light at a wavelength comprising:</p> <ul style="list-style-type: none">a first phase shift section, a half tone section, and a second phase shift section;said first phase shift section adjacent to said half tone section;said half tone section adjacent to said second phase shift section;said first phase shift section and half tone section changing the phase of incident light by about 180 degrees with respect to said second phase shift section.

No Reference suggest applicant's claim 1 limitations

No reference suggests claim 1 limitation of "said first phase shift section adjacent to said half tone section; said half tone section adjacent to said second phase shift section;". For example, in a non-limiting example shown in figure 1A, see light thru regions A, B and C. See spec. p. 13, table 1.

Ishikawa teaches against applicant's claim 1 by teaching the masks for Ishikawa figures 1, 2A, 2B and 2C. These mask do not meet claim 1 limitations. A careful reading of Ishikawa's spec 0038 to 0040 shows that Ishikawa masks in figures 2A 2B and 2C have total 100% opquage light blocking layers 2 that transmit no light.

Argument from the instant office action.

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The instant office action states:

Ishikawa teaches on page 3, in section [0038] that the light-blocking film 2 can be a semi-transparent film (half-tone type phase shift mask).

And in section [0040]. The mask of FIG. 2A is formed at light-passing regions 4a, 4b with trenches differing in depth. Due to this, light passing through the light-passing regions 4a and light passing through the light-passing regions 4b are inverted in phase. The masks of FIGS. 2B and 2C are formed at light-passing regions 4b with phase shifters 5 having predetermined refractive indexes and thicknesses. Due to this, light passing through the light-passing regions 4a and light passing through the light-passing regions 4b invert in phase. The phase shifter 5a may be formed either on the quartz substrate via the light-blocking film as shown in FIG. 2B or between the quartz substrate and light-blocking film as shown in FIG. 2C.

The claims recite that the phase shift is referenced with respect to the incident light, however, it is the relative phase shift that produces the destructive interference at the image level. Ishikawa teaches the relationship between a phase region, a halftone shifting region and a light transmissive region.

Ishikawa figure 1 and spec 0038 and 0039 do not suggest applicant's claim 1.

Ishikawa spec 0038 and 0039 states:

[0037] FIG. 1 is a cross-sectional view of an example of a photomask to which the mask inspection and production methods of the present invention are applied. As shown in FIG. 1, a predetermined pattern of light-blocking regions is formed by a light-blocking film 2 on a glass substrate 1. Non-light-blocking regions are not formed with the light-blocking film 2. A binary mask is a mask wherein the light-blocking film 2 does not pass any light. Modified illumination is used as the super-resolution technique for the usual binary mask.

[0038] When the light-blocking film 2 is a semi-transparent film (half-tone type phase shift mask), modified illumination need not be used, but can be used in combination if desired. It is also possible to apply the present invention to inspection and production of a Levenson phase shift mask or other photomask.

Figure 1 shows a conventional binary mask. See 0037.

Ishikawa 0038 statement about film "light-blocking film 2 is a semi-transparent film (half-tone type phase shift mask)" is ambiguous at best. The 0038 does not state that the film 2 specifically in figure 1 is transparent. No where in 0038 does Ishikawa refer to any feature in Ishikawa figures 1, 2A, 2B or 2C.

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Even assuming *arguendo* that Ishikawa suggests that the "light-blocking film 2 is a semi-transparent film" in figure 1, the mask in figure 1 is not a phase shift mask. Ishikawa's film 2 is semi-transparent film that means (dictionary definition and meaning to "those skilled in the art") "partially transparent". **Therefore, Ishikawa's film 2 is not a phase shifting layer.** Therefore, the mask in Ishikawa figure 1 does not meet claim 1.

Ishikawa's figures 2A, 2B and 2C show conventional phase shift mask with opaque layer 2.

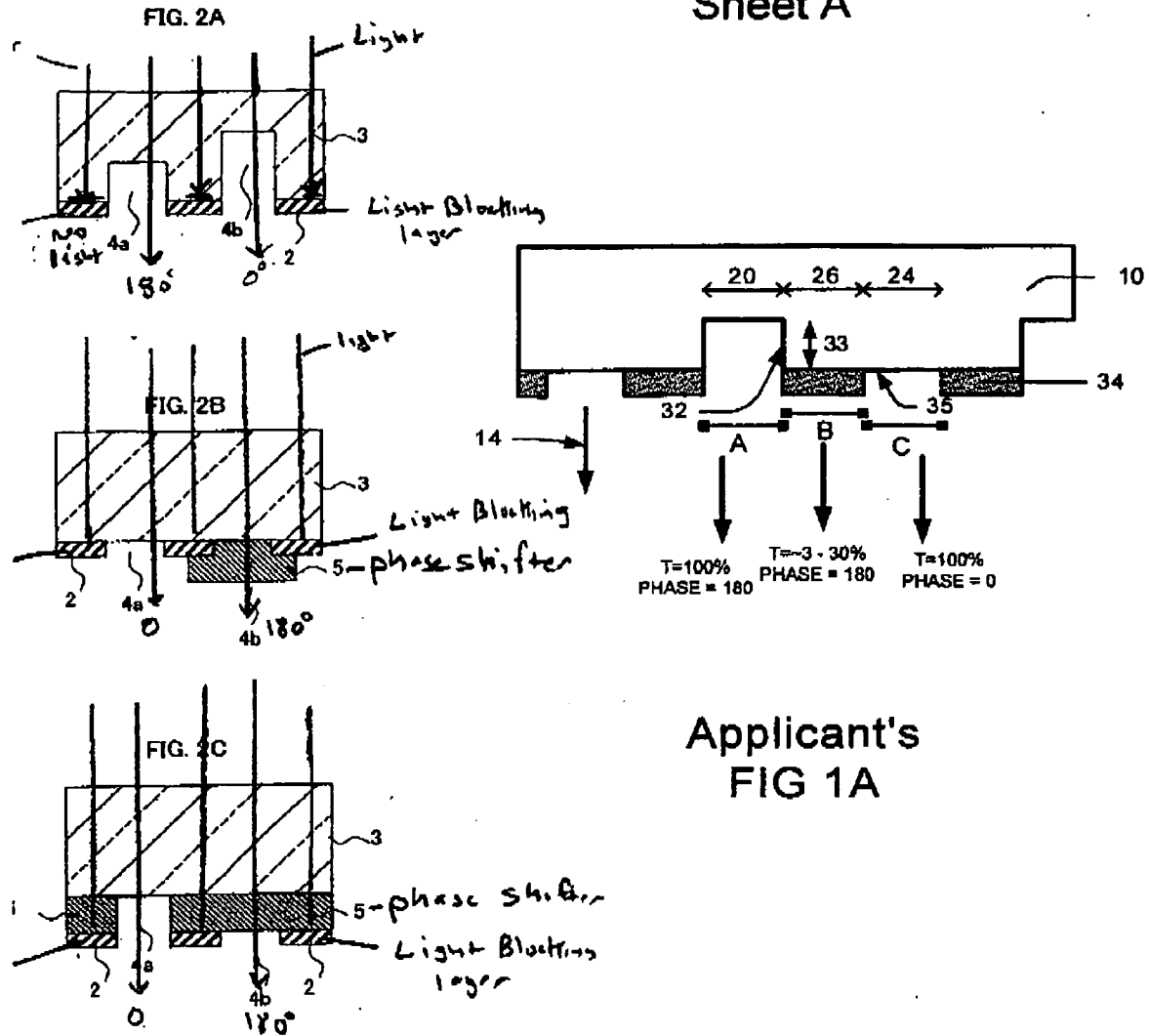
The office action argues: "Ishikawa teaches on page 3, in section [0038] that the light-blocking film 2 can be a semi-transparent film (half-tone type phase shift mask). " However, this is an incorrect interpretation. First Ishikawa Para 0038 clearly is not referring to figures 2A, 2B and 2C. As will be discussed below Para 0038 the masks in figs 2A, 2B and 2C do not function properly if film 2 as a semitransparent layer and would contain erroneous duplicate phase shift layers (5).

The figure below shows Ishikawa's figure 2A, 2B and 2C with the proper interpretation of film 2 as an "light blocking layer that does not pass any light" (see 0038).

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Sheet A



US 2004/0018436 A1
 Figs. 2A, 2B, 2C

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As shown in the sheet A, figures above, no light passes thru film 2 thus figures 2A, 2B and 2C show conventional phase shift masks.

The office action appears to argue that the film 2 can be semi-transparent. If film 2 is semitransparent (no phase shift) the figures do not meet applicants claims.

If the office action is arguing that the film 2 can be a semi-transparent, phase shifting layer, then the spec 0039 0040 and figures do not make sense. (Applicant strongly argues that Ishikawa's does not suggest film 2 in figures 2a, 2B and 2C, be semi-transparent and phase shifting.)

para 0039

[0039] FIGS. 2A to 2C are cross-sectional views of examples of phase shift masks. As shown in FIGS. 2A to 2C, a quartz substrate 3 has a light-blocking film 2 formed on it. The regions between parts of the light-blocking film 2 serve as light-passing regions. In a phase shift mask, phases of passing lights invert between adjacent light-passing regions.

First, 0039 states that figures are "phase shift masks" (not half tone phase shift masks). Second, 0039 states that "The regions between parts of the light-blocking film 2 serve as light-passing regions." Therefore, the regions under film 2 are NOT light passing regions (i.e., no light passes thru film 2). Third, Ishikawa film 2 in figs 2A to 2C has darker cross lines than in figure 1 thereby representing the film 2 in figs 2A to 2C is opaque and different than the film 2 in figure 1.

[0040] The mask of FIG. 2A is formed at light-passing regions 4a, 4b with trenches differing in depth. Due to this, light passing through the light-passing regions 4a and light passing through the light-passing regions 4b are inverted in phase. The masks of FIGS. 2B and 2C are formed at light-passing regions 4b with phase shifters 5 having predetermined refractive indexes and thicknesses. Due to this, light passing through the light-passing regions 4a and light passing through the light-passing regions 4b invert in phase. The phase shifter 5a may be formed either on the quartz substrate via the light-blocking film as shown in FIG. 2B or between the quartz substrate and light-blocking film as shown in FIG. 2C.

Fourth, 0040 has extensive discussion of the phase of light that passes between the "light blocking film 2". However, 0040 does not mention any light passing thru the "light blocking film 2" nor the change in phase of the light, nor the interference with light thru adjacent regions.

Fifth, Ishikawa's invention is an inspection system, not a mask. If applicant's claim 1 mask was known, then there would be many references that show this mask and explain

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how it works. The area of Phase shift masks is crowded and old. The absence of references is an indication of the non-obviousness of the application's masks.

Therefore, given the figs and context of paragraphs 0038-0040, the only reasonable interpretation for one skilled in the art of the light shielding layer is of an 100% opquage (totally light blocking layer) in at least ishkara's figures 2A, 2B and 2C.

Applicant respectfully requests clarification

The office action page 3 argues:

Ishikawa teaches the relationship between a phase region, a halftone shifting region and a light transmissive region.

Unfortunately, the applicant's attorney does not understand why the office action posits that Ishikawa teaches applicant's claim 1. Applicant respectfully requests clarification from the examiner.

The applicant makes the following arguments and can make more specific arguments if the next office action provides a claim chart.

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FIG. 2A

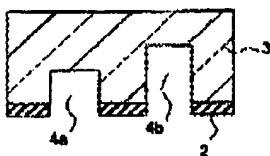


FIG. 2B

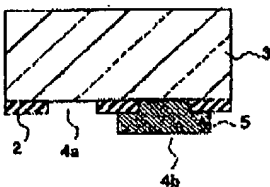
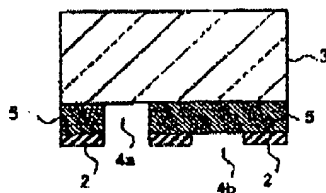


FIG. 2C



Phase shift of transmitted light.

The office action on page 3, 4th paragraph states:

The claims recite that the phase shift is referenced with respect to the incident light, however, it is the relative phase shift that produces the destructive interference at the image level. Ishikawa teaches the relationship between a phase region, a half-tone shifting region and a light transmissive region.

The claims are amended as discussed above to claim the relative phase shift between the regions of the transmitted light (light transmitted thru the mask).

Claim 2 is non-obvious

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Claim 2 states:

2. (ORIGINAL) The phase shift mask of claim 1 which further includes said first phase shift section comprised of a first phase shift region of a mask substrate;
a trench in said first phase shift region; and
said half tone section comprised of (i) a half tone region of said mask substrate and (ii) a half tone layer over said half tone region;
said second phase shift section has about a 0 degree phase shift.

Ishikawa does not show or suggest claim 2 limitations including the single trench. (See Ishikawa, figs 1, 2a-2C, para 0037-0040).

Applicant's claim 5 is non-obvious

Claim 5 depends from non-obvious parent claim 1.

Parent Claim 8 is non-obvious

Claim 8 is non-obvious over the cited references for the same reasons as stated above for claim 1.

Applicant's claim 13 is non-obvious

Claim 13 depends from non-obvious parent claim 1.

REJECTIONS UNDER 35 USC 103

Rejection of Claims 1-57 under 35 103(e) as being unpatentable over Ishikawa (2004/00118436) ('436)

The rejection of claims 1-57 under 35 USC 103(e) as being unpatentable over Ishikawa (2004/00118436) ('436) is acknowledged. reconsideration is respectfully requested in view of the amendments and the remarks below.

The office action on pages 3- 4 makes similar arguments as described above for the 102 rejections.

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Claims 1 – 57 are non-obvious for the reasons stated above for the 102 rejections. In addition, claims 1- 57 are non-obvious because they contain many non-obvious limitations in addition to the limitations in claims 1, 2, 5, 8 and 13. See as amended claims 1-57. Furthermore, the office action did not explain how and where in Ishikawa the limitations of claims 1-57 are met or suggested.

A few of the office actions' arguments are discussed below.

Ishikawa does not teach a phase shifting, semitransparent film 2 in Ishikawa's figs 2A, 2B and 2c.

As discussed above, the office actions statement on page 4, that ishikawa's film 2 can be semitransparent may be correct as discussed in 0038. But there is no support or reasoning or contextual support that this extends to 0039 and 0040. As discussed above, 0039 and 0040 (figs 2A-2C) teach only a 100% opquage layer.

Office action page 5,

The teaching of ishikawa et al. al differ form those so of the applicant in that the application teaches that the phase shift is referenced with respect to the incident light and specification amount of light transmission through the mask are claimed.

However, it is the relative phase shift that produces the destructive interference at the image level. Ishikawa teaches the relationship between a phase region, a halftone shifting region and a light transmissive region.

Amended claims 1 and 8 claim "transmitted light", not incident light.

The office action on page 5 argues:

Ishikawa teaches the same spatial relationship between a phase shifting region, a half tone region and a second phase shifting region and wherein the half-tone region is adjacent to the first phase shifting region and has the same phase of light transmission as this phase shifting region.

However, applicant submits that Ishikawa does not teach the spatial relations. Ishikawa does not teach/suggest applicant's half tone layer that phase shifts the transmitted light. See claim 1. Ishikawa does not suggest the transmittance's of the dependent claims.

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In contrast Ishikawa suggest conventional phase shift masks shown in Ishikawa figures 2A, 2B and 2C.

No reason to modify Ishihara to met the applicants claimed transmittance

There is no reason to modify Ishihawa to met the applicants claimed transmittance ranges for the half tone regions (e.g. claims 3, 4.. etc). The office action on page 5, last paragraphs does not provide a sufficient reasoning for the modification of Ishikawa's 100% opquage film 2 to applicant phase shifting, half tone layers which have claimed transmittance ranges.

The office action page 5, last paragraph gives a reason as that "one skilled in the art would know to adjust the relative phase of incident light and the amount of transmittance to meet the design specifications." First, applicant amended claims claim the "transmitted light", not incident light. Second, there is not prior art teaching to suggest changed the opaque film 2 to applicant's claimed film, would change/improve the mask performance. Third, there is no teaching of a "specific mask requirement" nor of any suggesting that one could change a conventional phase shift mask to applicant's claimed mask.

Fourth, The modification of Ishikawa to met claim 1 and claim 3, 4 etc..) goes against the teaching of Ishikawa's para 0039 and 0040 that state that the only light passing regions are 4a 4b (figs 2A-2C) and do not suggest any light passing thru the film 2.

Therefore the limitations of Claims 1-57 are not suggested by Ishikawa.

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CONCLUSION

In conclusion, reconsideration and withdrawal of the restriction are respectfully requested. Applicant has made election to invention I claims with traverse. Allowance of all claims is requested. Issuance of the application is requested.

It is requested that the Examiner telephone the undersigned attorney at (215) 670-2455 should there be anyway that we could help to place this Application in condition for Allowance.

Charge to Deposit Account

The Commissioner is hereby authorized to apply any fees or credits in this case, which are not already covered by check or credit card, to Deposit Account No. 502018 referencing this attorney docket. The Commissioner is also authorized to charge any additional fee under 37 CFR §1.16 and 1.17 to this Deposit Account.

Respectfully submitted,

Date: 10/22/05

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